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BRIEF COMMUNICATION

Clinical efficacy of the Er:YAG laser treatment on hypersensitive dentin

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Dentin hypersensitivity is a common symptomatic condition that causes discomfort and sometimes severe pain. The purpose of this study was to evaluate the clinical efficacy of the erbium-doped:yttrium, aluminum, and garnet (Er:YAG) laser treatment on cervically exposed hypersensitive dentin. Twenty patients with dentin hypersensitivity of caries-free teeth were selected. A visual analog scale (VAS) was used to measure dentin sensitivity in response to air stimulus. A 2-minute Er:YAG laser (energy level: 60 mJ/pulse; repetition rate: 2 Hz) was applied to cervically exposed hypersensitive dentin. After 4 weeks, the hypersensitive teeth were examined again, and the VAS score was measured again and recorded. No complications such as detrimental pulpal effects were observed. Eighteen participants reported significantly reduced dentin hypersensitivity 4 weeks after the laser desensitization treatment. The VAS scores measured 4 weeks after the Er:YAG laser desensitization treatment were significantly decreased as compared with those measured at the baseline ($p < 0.05$). In conclusion, the Er:YAG laser desensitization treatment can effectively reduce hypersensitivity of cervically exposed hypersensitive dentin.

Introduction

Dentin hypersensitivity is one of the most common symptomatic conditions that causes discomfort in patients. When thermal, tactile, osmotic, and mechanical stimuli (such as tooth brushing, sweet and sour foods, and hot or cold water) are applied to the exposed dentin, patients feel a short sharp pain, which is termed as dentin hypersensitivity.[1] Most dentin hypersensitivity is a result of abrasion, attrition, erosion, abfraction, gingival recession, and improper brushing habits. Sites of predilection in descending order are the canines, first premolars, incisors, second premolars, and molars.[2] In a previous study by Shen et al, the prevalence rate of dentin hypersensitivity in Taiwan was reported to be up to 38%.[3]

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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Although several theories have been put forward to explain the mechanisms involved in dentin hypersensitivity, the most widely accepted theory is the so-called hydrodynamic theory of sensitivity.[4] This theory postulates that rapid shifts, in either direction, of fluids within the dentinal tubules following stimulus application result in activation of sensory nerves in the pulp/inner dentin region of the tooth.

Treatment options for dentin hypersensitivity may include mucogingival surgery, pulpectomy, and the application of resin, lasers, topical desensitizing agents, as well as desensitizing toothpaste.[1,5] Laser desensitization has been introduced as an effective tool for rapidly eliminating or reducing dentin hypersensitivity. Recently, four types of lasers, namely, (1) neodymium-doped:yttrium, aluminum, and garnet, (2) CO_2, (3) gallium—aluminum—arsenide (diode), and (4) Er:YAG (erbium-doped:yttrium, aluminum, and garnet) are commonly used in the treatment of dentin hypersensitivity, and the effectiveness of the treatment depends on the laser type and parameters used.[6,7] However, laser therapy can reduce dentin hypersensitivity-related pain, but the evidence for its effectiveness is weak, and the possibility of a placebo effect must be considered.[8]

The Er:YAG laser produces a pulsed beam with a wavelength of 2940 nm. It is expected to show efficiency in medical and dental applications because of its thermomechanical ablation mechanism and the high absorption of its wavelength by water.[9] According to the hydrodynamic theory, decreases in dentinal fluid movements would directly result in a decrease of dentin hypersensitivity. Thus, the application of Er:YAG laser would be anticipated to decrease these fluid movements by evaporating the superficial layers of the dentinal fluid. However, little is known about the clinical effects of Er:YAG laser on dentin hypersensitivity. The purpose of this study was to evaluate the clinical efficacy of an Er:YAG laser (KEY Laser 3, KaVo, Biberach, Germany) on cervically exposed hypersensitive dentin.

Materials and methods

Patient selection

This study was performed in the Department of Periodontics, Chung Shan Medical University Hospital. Twenty patients (nine males and 11 females) with cervically exposed hypersensitive dentin of caries-free teeth were selected after informed consent was obtained. The inclusion criteria were: (1) patients must have good general health with no known allergies to commercial dental products; (2) patients must not have used desensitizing toothpaste within the past 3 months; (3) the study teeth must be decay free and have no restorations; (4) the study teeth had to have Grade 1 clinical mobility; (5) the study teeth had to show signs of facial/cervical erosion, abrasion, and/or gingival recession; and (6) patients had to be able to read and understand the consent form and be willing to sign it. Exclusion criteria were: (1) teeth that had undergone periodontal surgery within the past 6 months or been scaled/root planed within the past 3 months; (2) pregnant or lactating women; (3) individuals demonstrating gross oral neglect or requiring extensive dental therapy; (4) teeth used as abutments for fixed or removable partial dentures, or teeth with full crowns or obvious cracks in the enamel; (5) patients who were unable to strictly adhere to product use; (6) patients who had taken certain medications (e.g., anti-inflammatory drugs or antibiotics) on a daily basis during the previous 7 days; and (7) patients suffering from a chronic medical disease or conditions that are associated with intermittent episodes or constant daily pain, such as arthritis.

Clinical measurements

A visual analog scale (VAS) is commonly used to assess dentin hypersensitivity. A VAS consists of a 100 mm line with 0 at one end indicating "not painful at all" and 100 at the other end indicating "extremely painful" as described previously.[2] In brief, the participant was asked to draw a vertical line on the horizontal scale at a point that corresponded to his/her reaction to the air stimulus. Teeth identified by the patient were tested for thermal sensitivity using a 1-second air blast 1 cm from the study tooth after isolating the tooth from the adjacent teeth using cotton rolls. Volunteers were asked to place a vertical mark on the line that represented the intensity of their pain on the 100 mm scale. Participants were asked to brush their teeth two times a day. Recordings were assessed prior to the laser treatment. Four weeks later, participants returned for the final examination of their preselected sensitive teeth as described earlier.

Treatments

Immediately prior to treatment, the examiner polished and flossed all teeth of the patients. An Er:YAG laser (KEY Laser 3, KaVo, Biberach, Germany) was applied using a laser handpiece 2060 at an energy level of 60 mJ/pulse, and a repetition rate of 2 Hz with water irrigation. The laser beam was handled in a defocused manner and the treatment time was 2 minutes per tooth by scanning the cervical part in an overlapping pattern. All the teeth with dentin hypersensitivity were treated once and evaluated 4 weeks later.

Statistical analysis

To determine the effect of KEY Laser 3 on hypersensitive teeth, VAS scores were analyzed using the Wilcoxon signed-rank test. A p value <0.05 was taken to be significant and was used for comparison.

Results

All the 20 patients completed the 4-week study period. No complications such as detrimental pulpal effects or allergic reactions were observed. The VAS scores of each patient at the baseline and 4 weeks after the Er:YAG laser desensitization treatments are shown in Table 1. Eighteen of the 20 participants were found to have significantly reduced

dentin hypersensitivity 4 weeks after receiving the Er:YAG laser desensitization treatment (Table 2). The percentage of improvement was 90% in this study. Table 2 illustrates the mean VAS scores in response to air stimuli at the baseline and 4 weeks after the Er:YAG laser desensitization treatments. The VAS scores were significantly reduced from 56.6 ± 11.8 mm at the baseline to 31.9 ± 13.8 mm 4 weeks after the Er:YAG laser desensitization treatment. The Er:YAG laser desensitization treatment was found to have a significant effect on reducing dentin hypersensitivity ($p < 0.01$).

Table 2 Mean VAS scores and ranges at baseline and 4 weeks after the Er:YAG laser desensitization treatments.

	VAS	
	Range	Mean ± SD
Baseline	30—78	56.6 ± 11.84*
4 Weeks	10—80	31.9 ± 13.84*

*Statistically significant between baseline and 4 weeks after the treatment ($p < 0.01$).
Er:YAG = erbium-doped:yttrium, aluminum, and garnet; VAS = visual analog scale.

Discussion

The mechanism of laser desensitization is the occlusion, by partial melting, of the exposed dentinal tubules after low-intensity irradiation.[10] In addition, an analgesic effect of laser irradiation on pulpal nerves may be implicated in the instant desensitization process.[11] The results of the present clinical trial demonstrated that desensitizing of hypersensitive dentin with an Er:YAG laser was effective for 4 weeks. Similar results were achieved by Schwarz et al[12] and Ehlers et al.[13] Both the groups demonstrated that Er:YAG laser showed an effective reduction of cervical dentin hypersensitivity compared with commercial desensitizing systems.

The Er:YAG laser treatment is expected to show efficiency in cervical dentin hypersensitivity owing to its thermomechanical ablation mechanism and the high absorption of its wavelength by water. Decreases of dentinal fluid movements would, according to the hydrodynamic theory, directly result in a decrease of dentine hypersensitivity. Thus, the application of an Er:YAG laser would be anticipated to decrease these fluid movements by evaporating the superficial layers of the dentinal fluid.

The present study has demonstrated that the Er:YAG laser treatment seems to be a suitable tool for successful reduction of dentine hypersensitivity. The improvement rate was as high as 90%. A limitation of the present study is the 4-week follow-up time, which could be regarded as rather short. Furthermore, because case report(s) and case series were performed without a control group, the interpretation is only based on observation of the relevant case(s). The parallel observation with different modes of Er:YAG or different types of lasers as controls should be performed in future to specify the advantages of this method in the reduction of dentin hypersensitivity.

Table 1 VAS scores of each patient at baseline and 4 weeks after the Er:YAG laser desensitization treatments.[a]

Patient number	VAS I (baseline)	VAS II (4 weeks)
1	78	53
2	57	26
3	41	18
4	70	75
5	58	26
6	49	34
7	61	36
8	42	16
9	38	40
10	60	41
11	76	32
12	54	29
13	49	18
14	63	45
15	57	35
16	66	24
17	63	30
18	54	25
19	30	10
20	66	24

Er:YAG = erbium-doped:yttrium, aluminum, and garnet; VAS = visual analog scale.
[a] The percentage of improvement was 90% after the Er:YAG laser treatment.

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